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INT CL^4 H04B

(54) **A tuner-demodulator device**

(57) A self-contained tuner-demodulator device for use with a ground based satellite television signal reception antenna and low noise block down converter (LNB) capable of capturing satellite signals and providing a LNB output signal to a satellite receiver unit toward the viewing of television images upon a display monitor. An input and switching stage (11, 12, 13) accepts the received high frequency broad band satellite signal from the LNB which is then amplified by RF amplifier stages (15). An image tracking filter (16) selects a desired channel and provides an amplified high frequency signal which is combined with a local oscillator output (21) by a mixer stage (20) towards providing an IF television signal. IF amplifiers (26, 32) and filters (27) amplify and isolate the signal which is thereafter converted to a base band television signal by a FM demodulator (36).

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

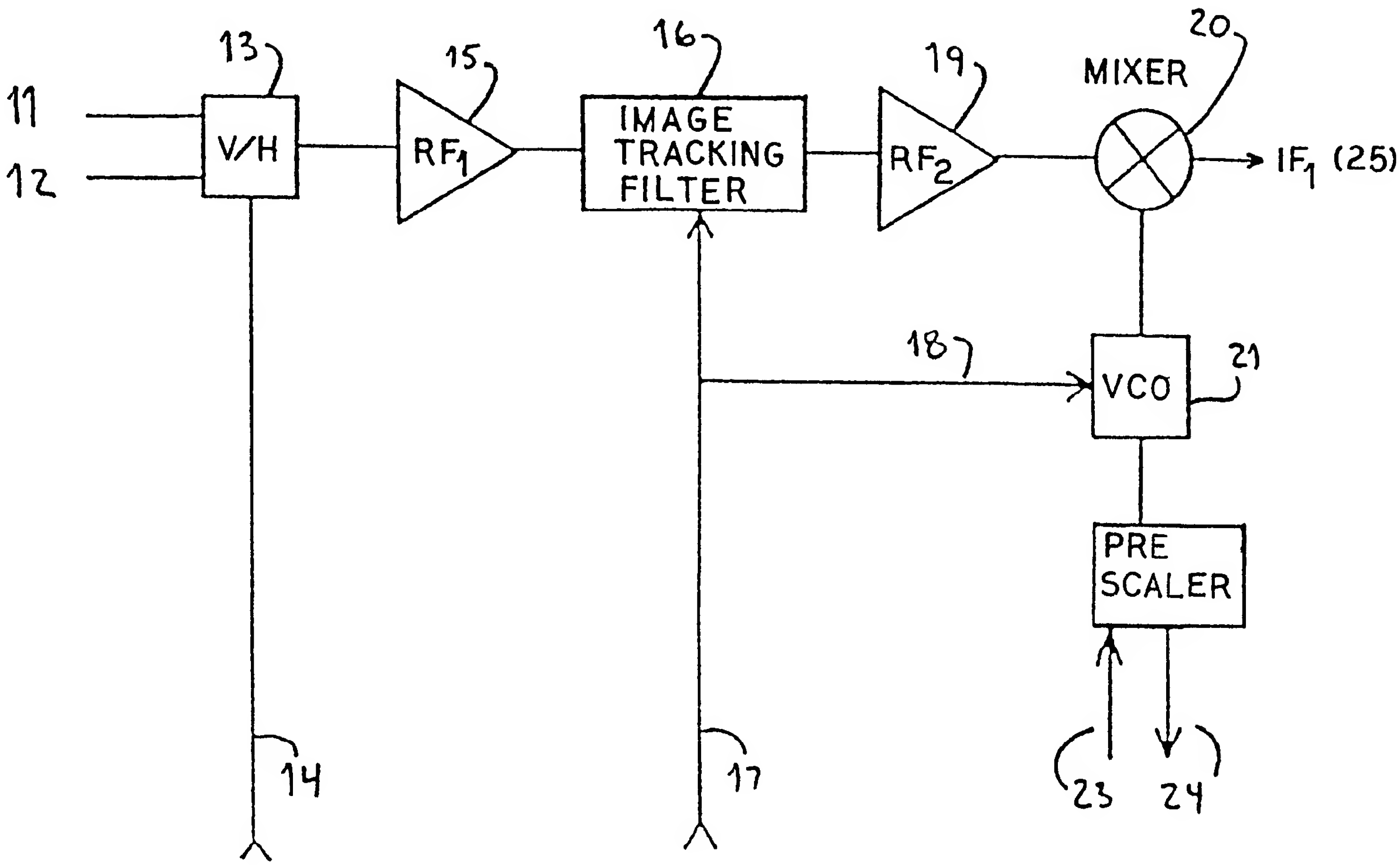
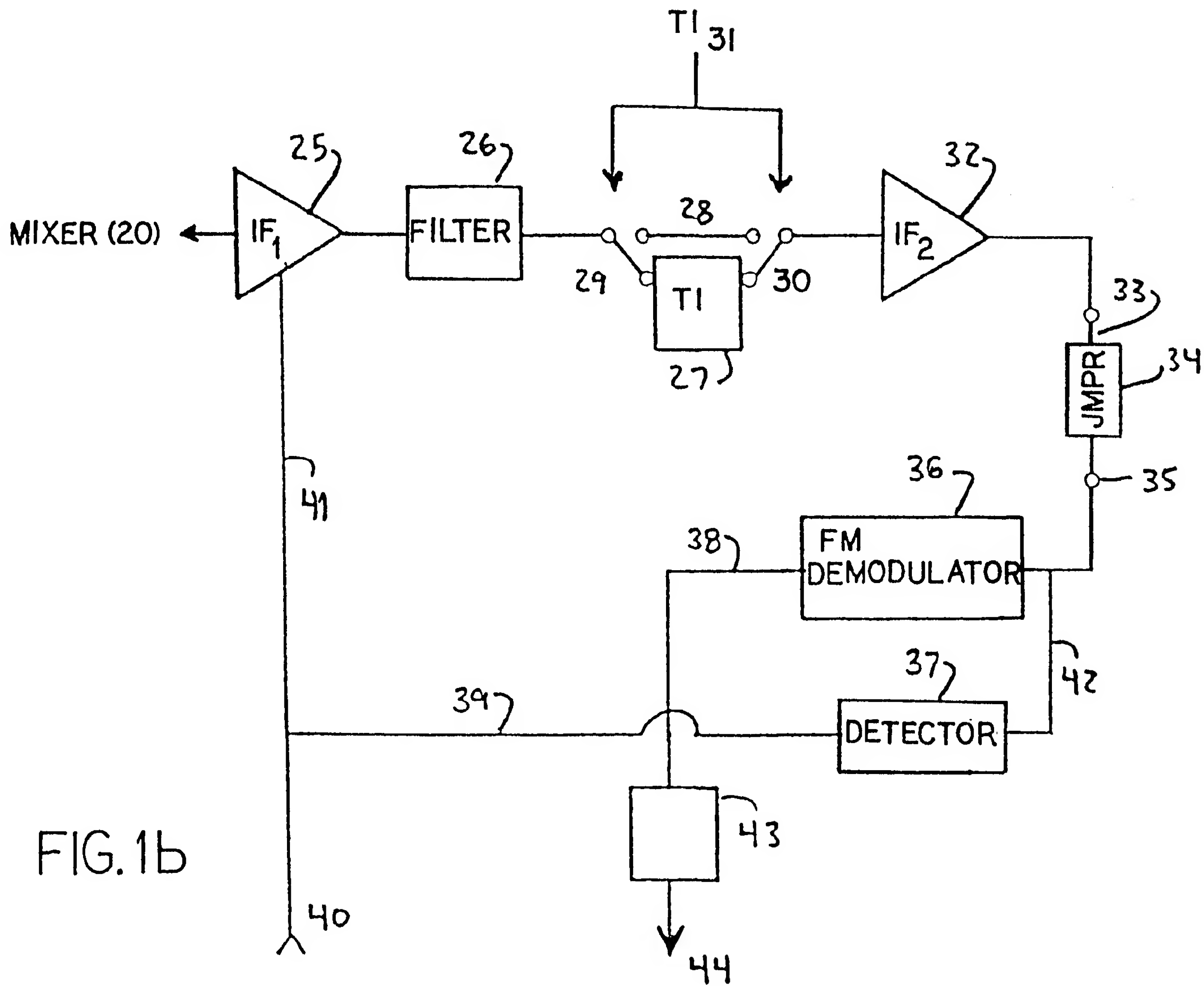
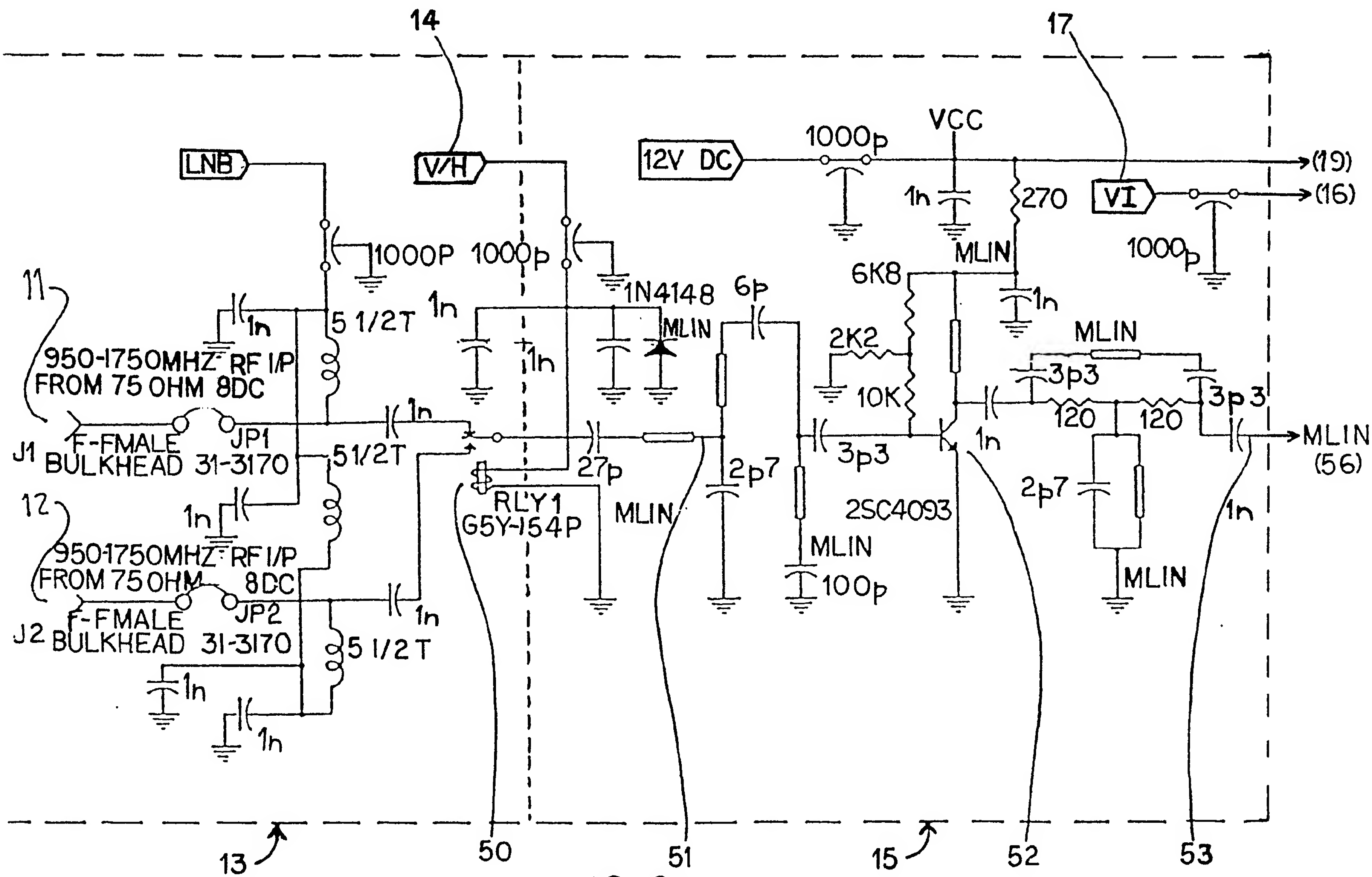

11
12
13
V/H
14
15
RF1
16
IMAGE
TRACKING
FILTER
17
18
19
RF2
20
MIXER
IF1 (25)
VCO
21
PRE
SCALER
23
24

FIG. 1a



MIXER (20)
IF1
25
FILTER
26
TI
31
28
29
TI
27
30
IF2
32
33
JMPR
34
35
36
FM DEMODULATOR
38
41
39
37
DETECTOR
42
43
40
44

FIG.1b



14
17
LNB
V/H
12V DC
1000p
VCC
(19)
1n
270
VI
(16)
1000P
1000p
1000p
MLIN
6K8
11
1n
5 1/2T
1n
1N4148
6p
MLIN
1n
2K2
MLIN
950-1750MHZ RF I/P
FROM 75 OHM 8DC
1n
3p3
10K
J1
F-FMALE
JP1
BULKHEAD 31-3170
1n
120
120
3p3
MLIN
(56)
51/2T
27p
2p7
3p3
1n
12
RLY1
G5Y-154P
MLIN
2p7
1n
2SC4093
950-1750MHZ RF I/P
FROM 75 OHM 8DC
MLIN
100p
MLIN
J2
F-FMALE
JP2
BULKHEAD 31-3170
1n
5 1/2T
1n
1n
13
50
51
15
52
53

FIG. 2a

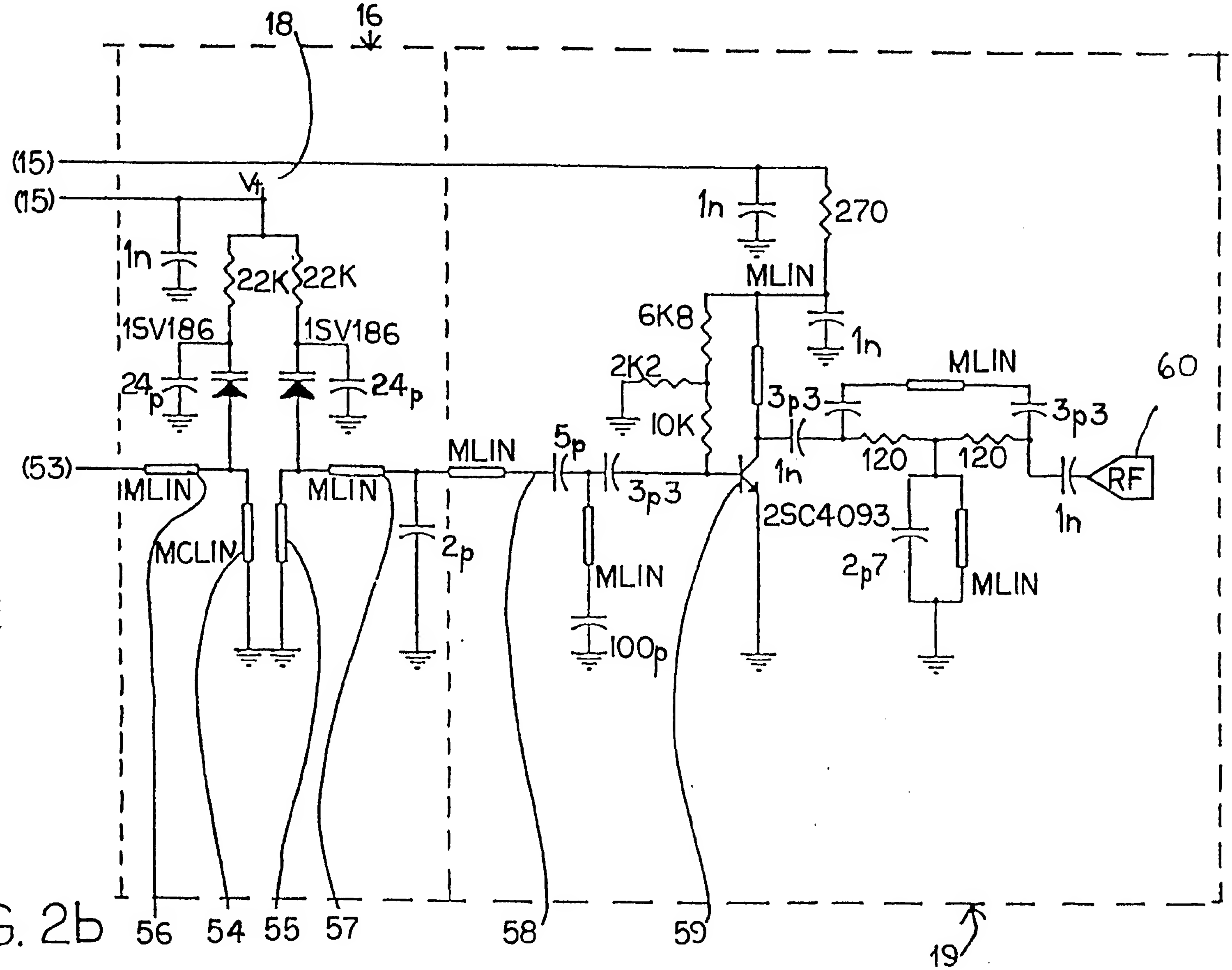

18
16
(15)
(15)
V1
1n
22K
22K
1SV186
1SV186
24p
24p
(53)
MLIN
MCLIN
MLIN
2p
MLIN
5p
3p3
MLIN
100p
6K8
2K2
10K
1n
270
MLIN
1n
3p3
1n
2SC4093
MLIN
3p3
120
120
2p7
MLIN
1n
RF
60
56
54
55
57
58
59
19

FIG. 2b

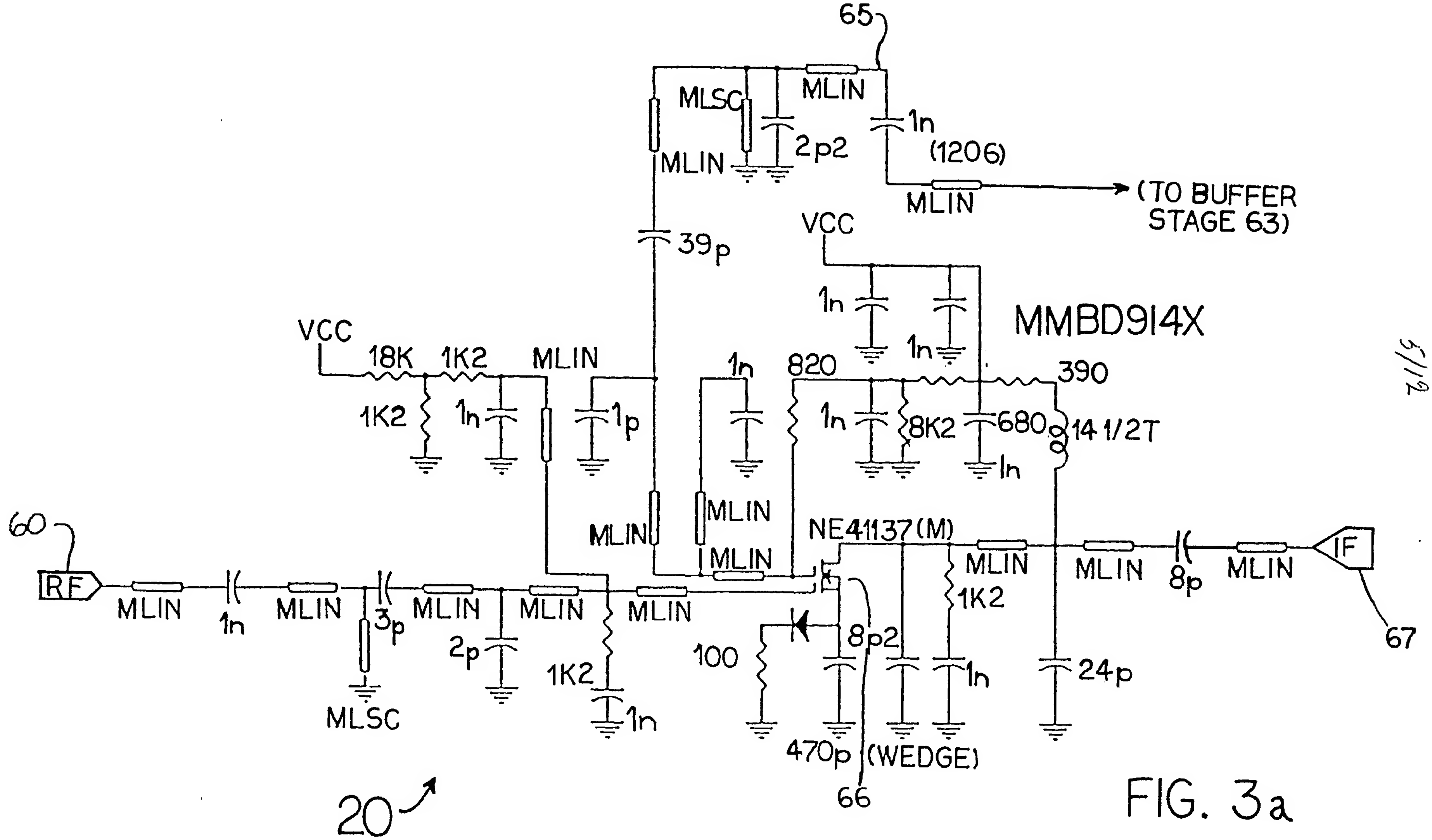

65
MLSC
MLIN
2p2
1n
(1206)
MLIN
(TO BUFFER STAGE 63)
MLIN
39p
VCC
1n
1n
MMBD914X
VCC
18K
1K2
MLIN
1n
820
390
1K2
1n
1p
1n
8K2
680
14 1/2T
1n
MLIN
60
MLIN
NE41137(M)
MLIN
MLIN
MLIN
8p
MLIN
IF
RF
MLIN
1n
MLIN
3p
MLIN
MLIN
MLIN
1K2
100
8p2
1n
24p
67
2p
1K2
1n
MLSC
470p
(WEDGE)
66
20

FIG. 3a

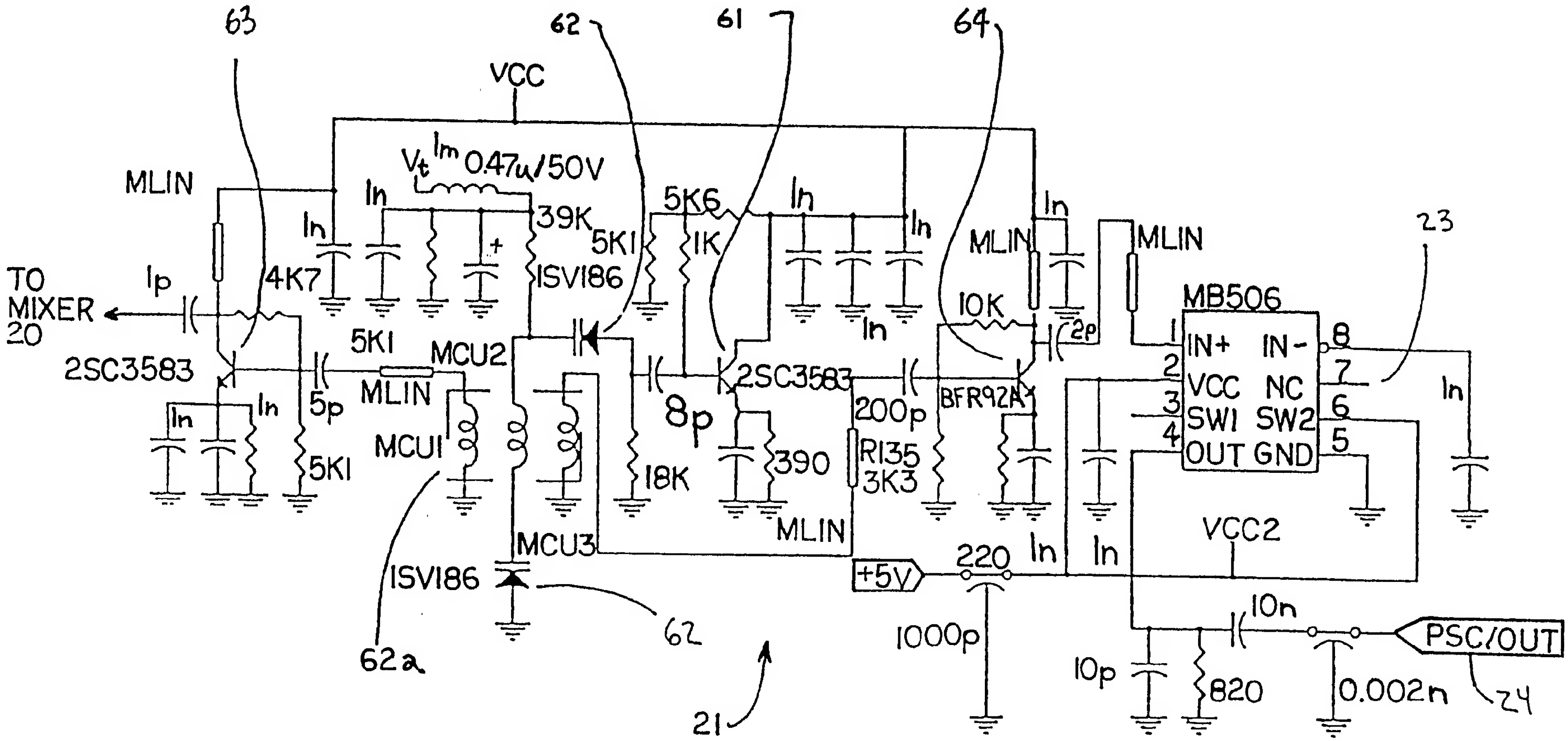

63
62
61
64
VCC
MLIN
V_t
I_m
0.47u/50V
In
39K
5K1
ISV186
5K6
1K
In
MLIN
10K
2p
MLIN
23
MB506
IN+
IN-
VCC
NC
SW1
SW2
OUT
GND
1
2
3
4
5
6
7
8
TO MIXER 20
Ip
4K7
2SC3583
5p
MLIN
MCU2
MCU1
5K1
8p
2SC3583
200p
BFR92A
R135
3K3
18K
390
MLIN
MCU3
ISV186
62a
62
21
+5V
220
1000p
VCC2
10n
PSC/OUT
24
10p
820
0.002n

FIG. 3b

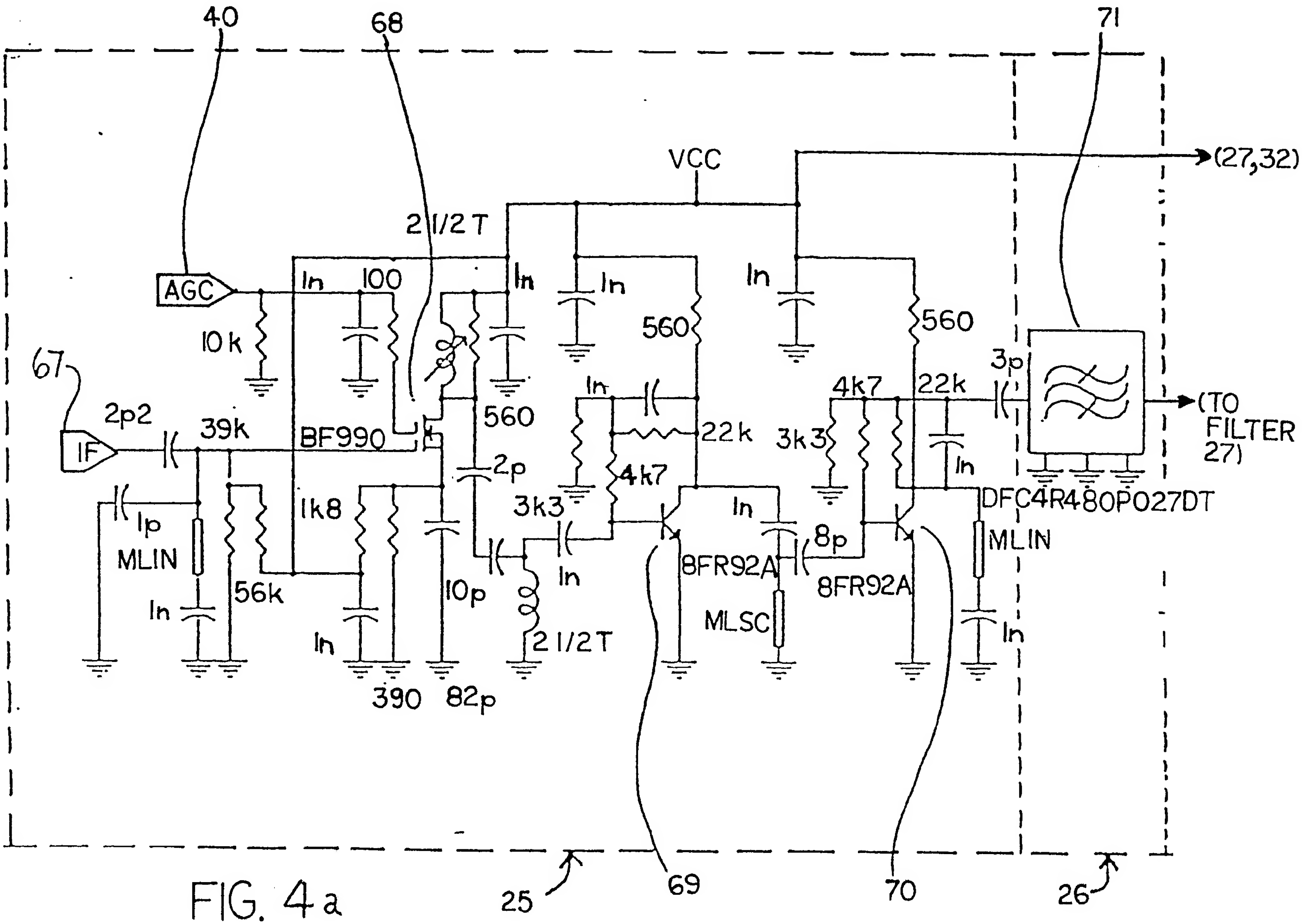

40
68
71
67
AGC
10 k
IF
2p2
39k
BF990
In
100
2 1/2 T
In
560
2p
1p
MLIN
56k
1k8
390
82p
10p
3k3
2 1/2 T
VCC
560
22k
4k7
8FR92A
MLSC
8p
3k3
4k7
22k
3p
8FR92A
DFC4R480P027DT
MLIN
(27,32)
(TO FILTER 27)
25
69
70
26

FIG. 4a

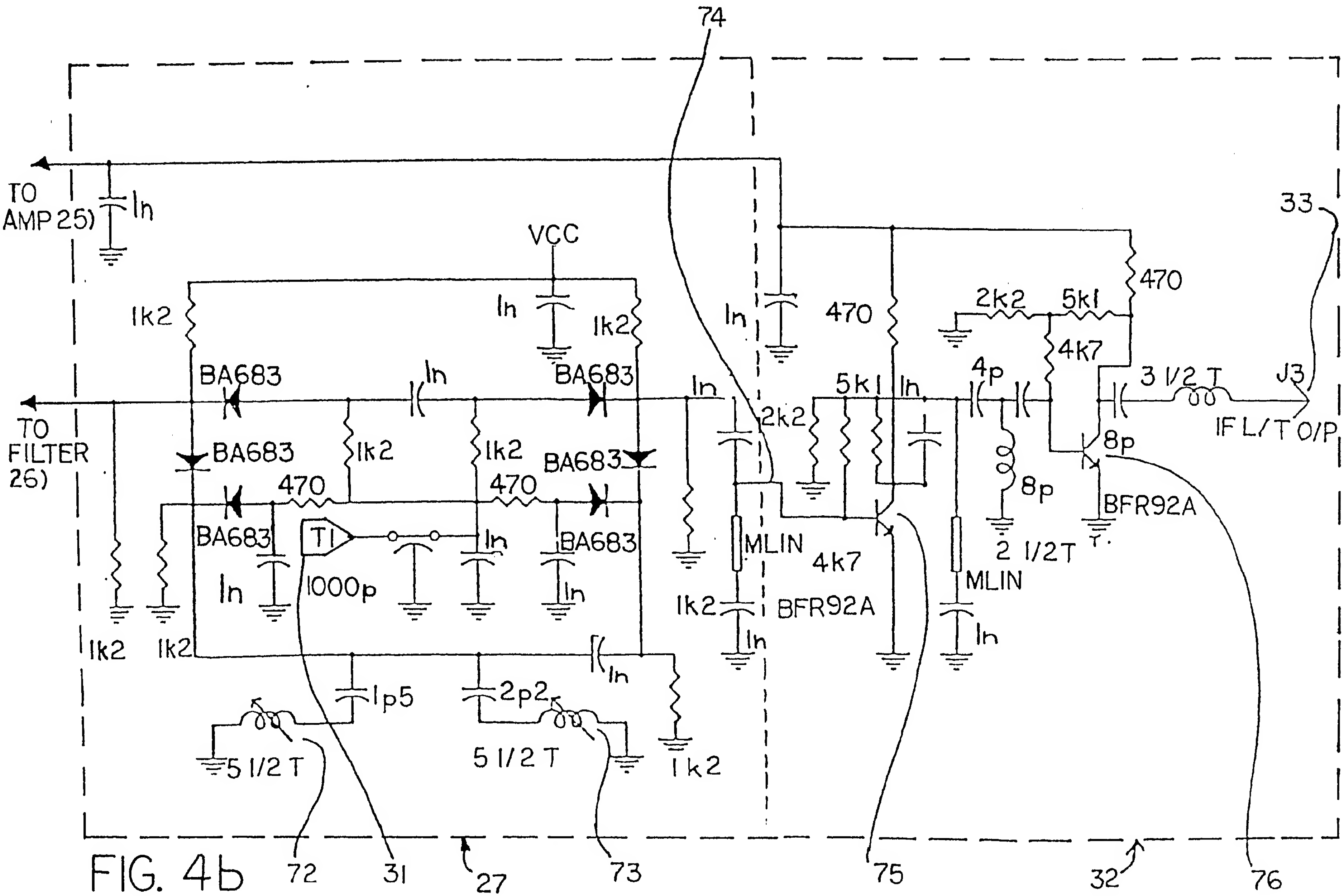

TO AMP 25)
TO FILTER 26)
VCC
1n
1k2
BA683
470
T1
1000p
1p5
2p2
5 1/2 T
MLIN
4k7
BFR92A
2k2
5k1
4p
8p
2 1/2T
3 1/2 T
J3
IF L/T O/P
33
74
72
31
27
73
75
32
76

FIG. 4b

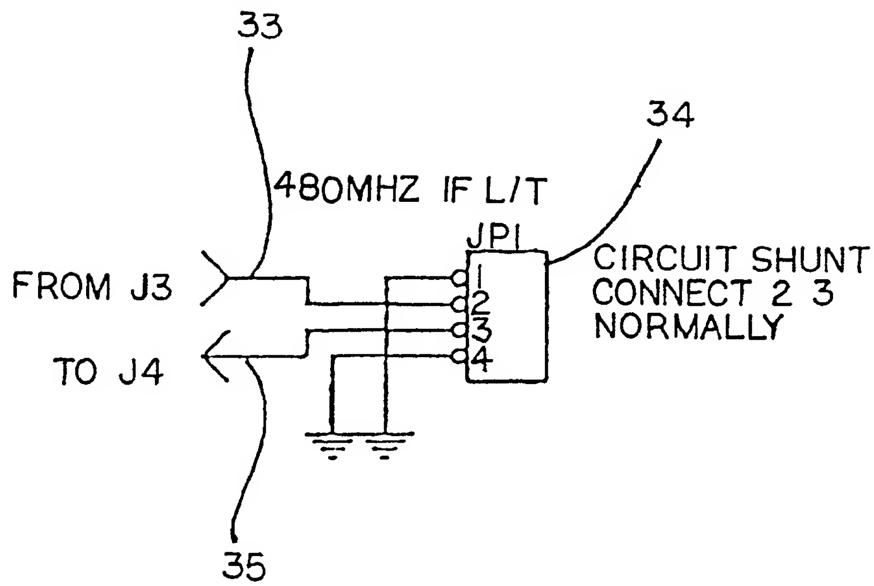

33
34
480MHZ IF L/T
JP1
FROM J3
TO J4
1
2
3
4
CIRCUIT SHUNT
CONNECT 2 3
NORMALLY
35

FIG. 5

10/12

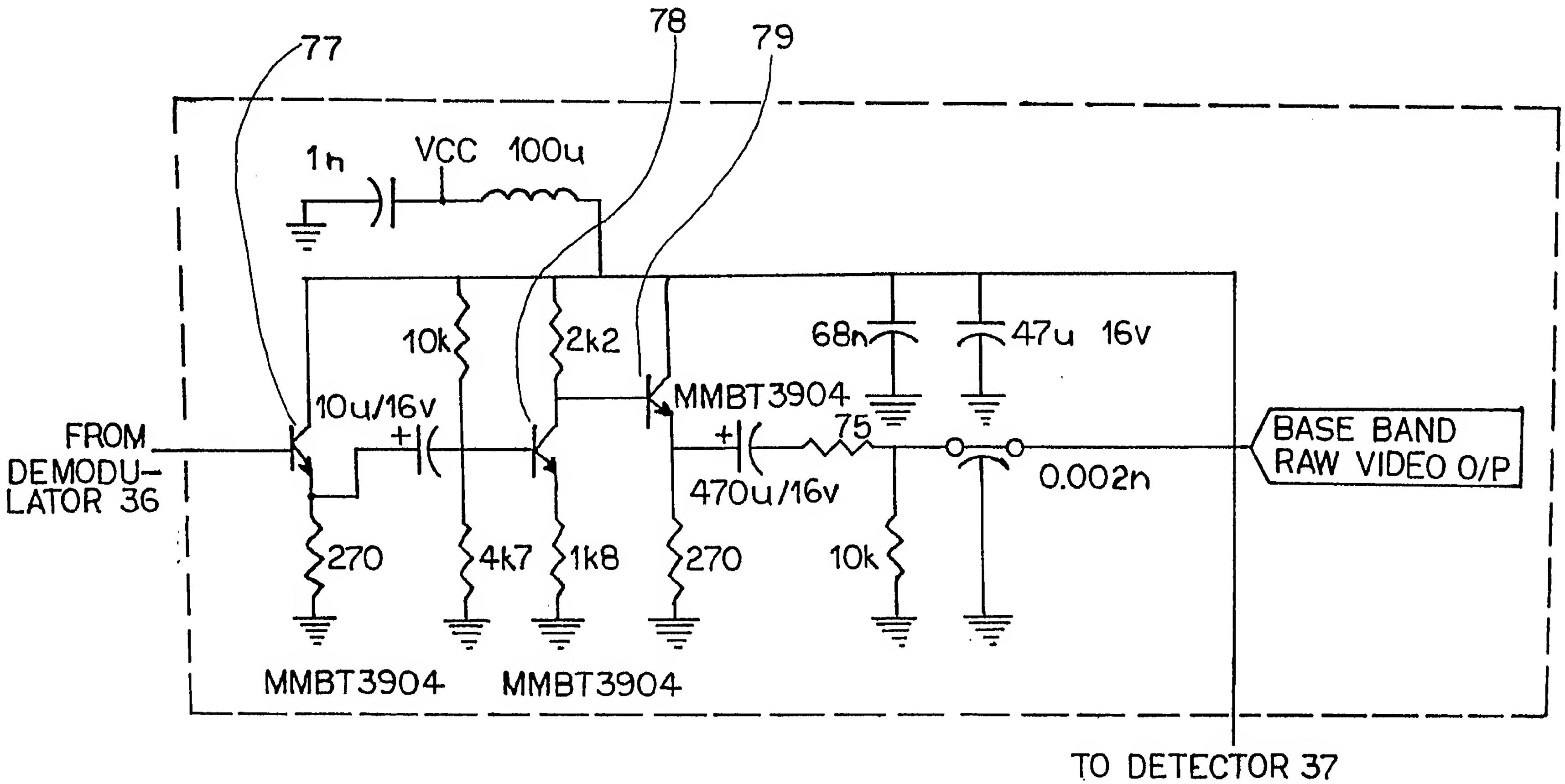

77
78
79
1n
VCC
100u
10k
2k2
MMBT3904
68n
47u 16v
10u/16v
FROM
DEMODULATOR 36
75
470u/16v
0.002n
BASE BAND
RAW VIDEO O/P
270
4k7
1k8
270
10k
MMBT3904
MMBT3904
TO DETECTOR 37

FIG. 6a

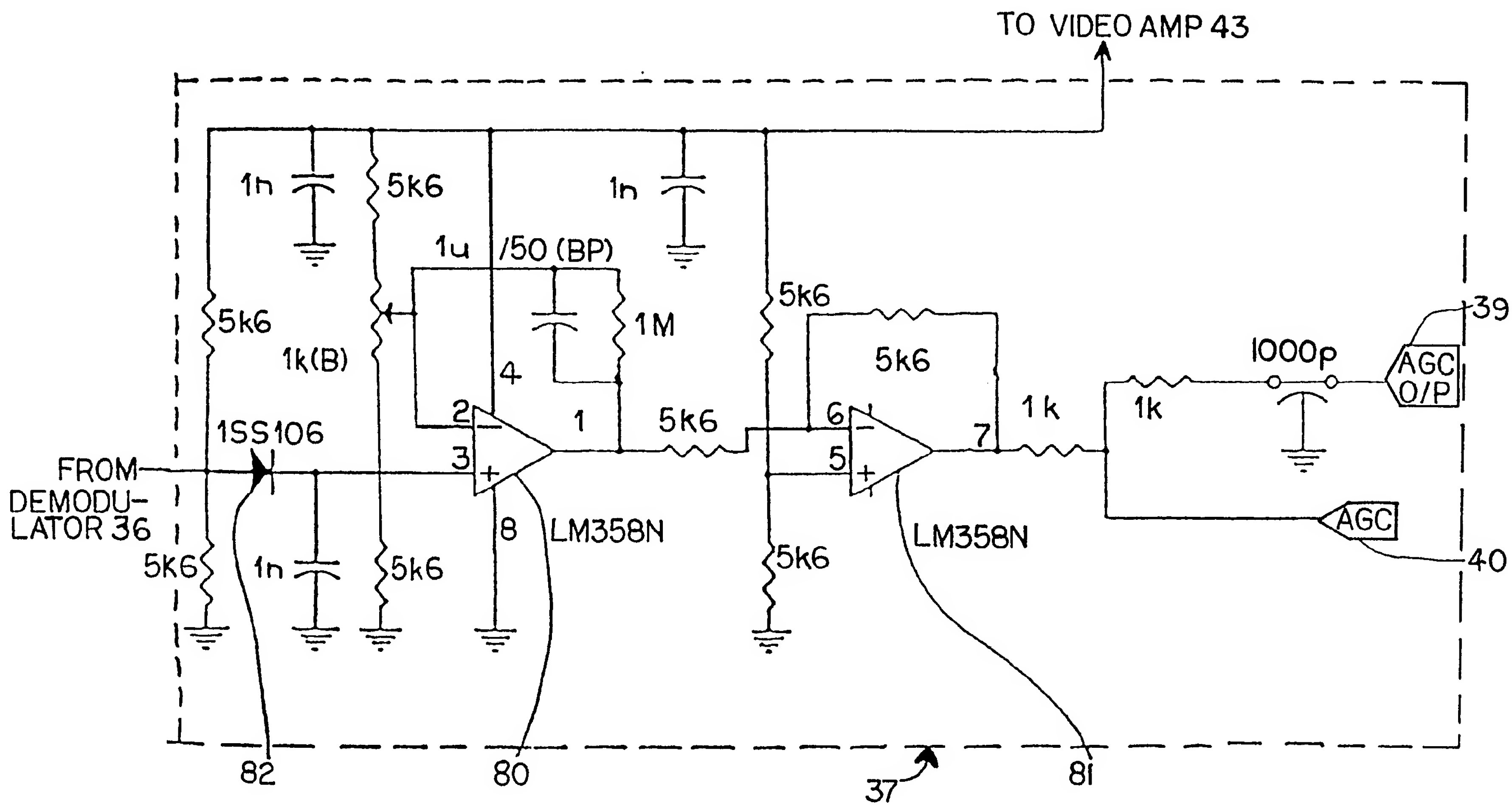

TO VIDEO AMP 43
FROM DEMODULATOR 36
1SS106
5k6
1n
5k6
1k(B)
1u /50 (BP)
1M
4
2
3
1
8
LM358N
1n
5k6
5k6
5k6
6
5
7
LM358N
1k
1k
1000p
AGC O/P
AGC
39
40
5K6
1n
5k6
5k6
82
80
37
81

FIG. 6b

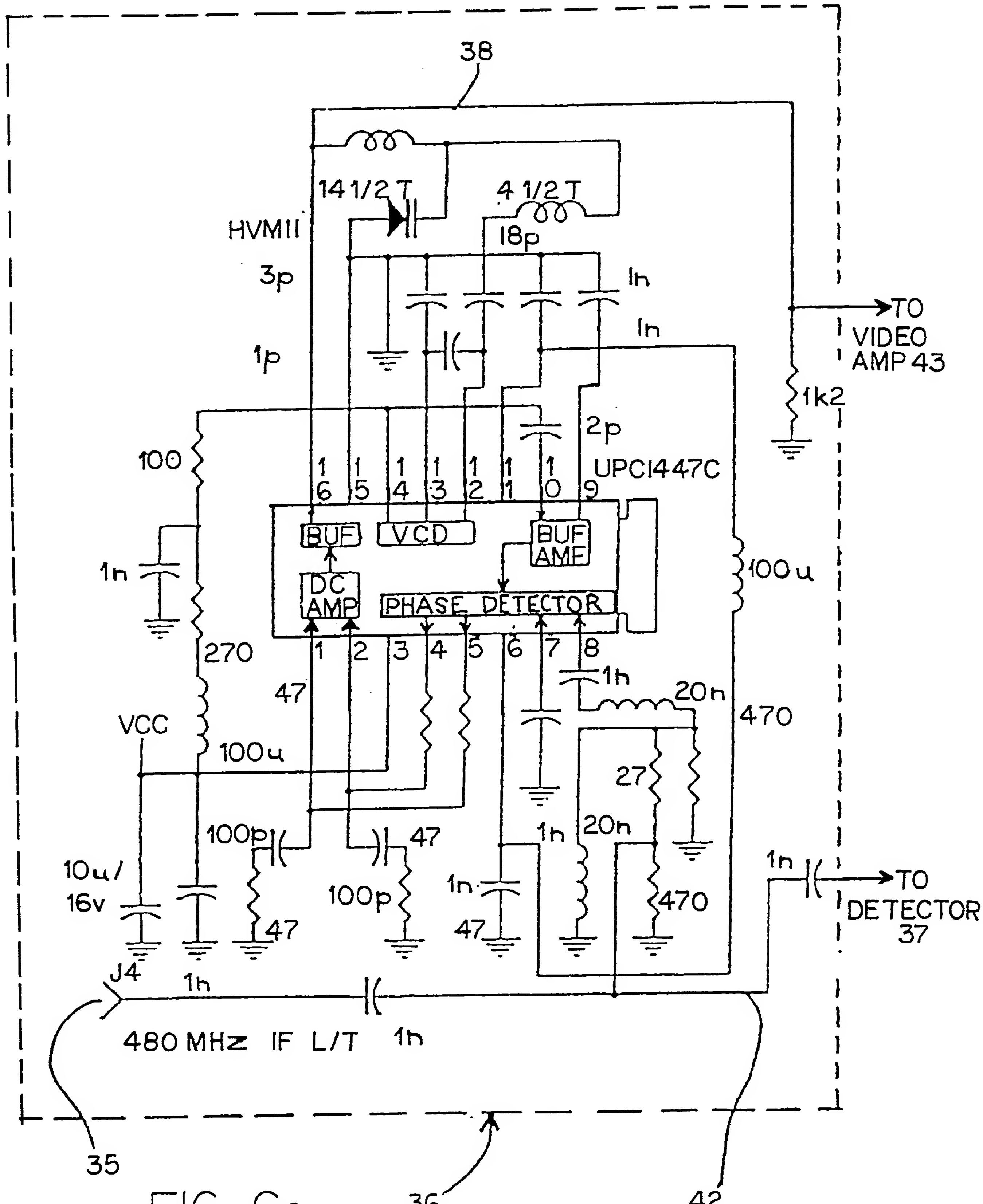

38
14 1/2 T
4 1/2 T
HVM11
18p
3p
1n
1n
1p
TO VIDEO AMP 43
1k2
2p
100
UPC1447C
16 15 14 13 12 11 10 9
BUF
VCD
BUF AMP
1n
DC AMP
PHASE DETECTOR
100u
1 2 3 4 5 6 7 8
270
1n
47
20n
470
VCC
100u
27
100p
47
1n
20n
1n
10u/16v
100p
1n
470
TO DETECTOR 37
47
47
J4
1n
480 MHz IF L/T
1n
35
36
42

FIG. 6c

2223900

TUNER-DEMODULATOR DEVICE

BACKGROUND OF THE INVENTION

The present invention relates in general to ground based reception of orbiting satellite relayed television signals, and in particular, to an improved self-contained tuner-demodulator subsystem for television satellite receivers which serves to select or "tune into" a particular television channel. The present tuner-demodulator device incorporates all of the necessary circuitry between the first intermediate frequency band (950-1750 MHz) presented to the satellite receiver dual input, and the demodulated based band (0-10MHz). While satellite television tuner-demodulator systems exist for the demodulation, manipulation and control of television signals received by ground based satellite antenna, and are capable of controlling and otherwise manipulating same towards use with a television monitor or display, few, if any such devices have addressed themselves or otherwise permitted flexible use with an alternative number of television system signals particularly in view of the growing number of commercial and consumer television system applications including, direct broadcast, SMATV, TVRO and MAC.

There are at present, and it can be expected in the future that there will be an increasing number of strong input signals as more and more countries either start or expand their DBS transmissions, and accordingly, an important requirement of a tuner-demodulator device is

to possess low intermodulation distortion.

Accordingly, the present invention, has as one of its objects, the provision of an improved tuner-demodulator device which possesses low inter-modulation distortion.

It is further an object of the present invention to provide a tuner-demodulator which possesses minimum intermodulation distortion in the various stages thereof and accordingly possess excellent performance of the first intermediate frequency and mixer stages so as to not be necessary to include gain control in the first intermediate frequency stage.

Another object of the present invention is to provide for matching the input of the tuner-demodulator to the 75 ohm impedance of coaxial cable and to further compensate for and otherwise control image rejection, second intermediate frequency rejection, gain and the suppression of oscillator radiation to other indoor units connected and parallel with the present device.

These and other objects of the invention will become apparent in light of the present specification, drawings and claims.

SUMMARY OF THE INVENTION

The present invention comprises a self-contained tuner-demodulator device for use with a ground based satellite signal reception antenna and a low noise block down converter (LNB) which is capable of capturing satellite relayed television signals and providing a block down converted radio frequency signal to a satellite receiver unit toward the viewing of television images upon a television display monitor. The low noise block down converter (LNB) is installed at the focus of the dish antenna to convert the 4 GHz satellite signal to a 1 GHz first intermediate frequency signal.

The tuner demodulator device comprises an input stage for operably and electrically connecting the tuner-demodulator device to the LNB. A first radio frequency amplifier operably and electrically connected to the input stage amplifies the LNB output signal which comprises a low power high frequency type signal.

A local oscillator, preferably a voltage controlled oscillator, is provided for converting the high frequency LNB output signal to an intermediate frequency signal. Associated with the local oscillator is a buffer operably and electrically associated therewith for isolating the local oscillator to prevent unwanted distortion of the LNB output signal.

An image tracking filter is operably and electrically connected to the first radio frequency amplifier, the image tracking filter serving to select the desired channel to be viewed on the television monitor. The image tracking filter serves to convert the broad band high frequency LNB output signal into a narrow

band signal, the particular band corresponding to the desired channel. A second radio frequency amplifier, operably and electrically to the image tracking filter, serves to amplify the narrower band LNB output signal corresponding to the selected channel.

A mixer is operably and electrically connected to the local oscillator, the buffer and the second radio frequency amplifier for combining the LNB output signal and the output of the oscillator towards the generation of a reduced frequency signal corresponding to the selected channel, preferably in a second intermediate frequency band distinct from the 1 GHz intermediate frequency signal generated by the LNB. A first intermediate frequency amplifier is electrically coupled to the mixer and serves to amplify the second intermediate frequency signal corresponding to the selected channel.

A first filter means operably and electrically connected to the first intermediate frequency amplifier is provided, together with a second intermediate frequency amplifier coupled to the first intermediate frequency amplifier both of which serve to amplify the signal corresponding to the selected channel. The demodulator is operably and electrically connected to the second intermediate frequency amplifier towards converting the intermediate frequency signal corresponding to the selected channel to a broad band signal suitable for use with a satellite receiver unit and television display monitor.

In the preferred embodiment of the invention, the tuner demodulator device further includes an input stage which incorporates a vertical/horizontal switch serving to permit selection between a horizontally

polarized and vertically polarized input signal collected by the ground based satellite reception antenna and modified by the LNB. The tuner demodulator further includes a prescaler for providing compatibility with digital tuning systems incorporating computer interfaces towards digital tuning and control of the tuning system.

A second filter means is preferably operably and electrically associated with the mixer for suppressing the local oscillator and first intermediate signals. The second filter may be fabricated as a band pass filter configured select a second intermediate frequency of 479.5 MHz.

The preferred embodiment of the invention may further include a terrestrial interference filter having a 13 MHz pass band for suppressing terrestrial noise and interference. Preferably, the terrestrial interference filter may be switchably connectable to the tuner-demodulator device towards its optional selective use. A jumper is operably and electrically connected between the second intermediate frequency amplifier and the demodulator wherein the jumper permits the interconnection of an external circuit or component, such as filters and/or other optional external demodulator devices. The jumper permits future expandability and compatibility of the present tuner-demodulator device with future television broadcast systems.

A detector means is preferably operably and electrically connected to the second intermediate frequency amplifier and the first intermediate frequency amplifier towards providing automatic gain control of the first intermediate frequency amplifier means. The detector serves to detect the level of the signal output from the second intermediate frequency amplifier and

compares same to a present level. The detector serves to automatically adjust the gain of the first intermediate frequency amplifier towards maintaining the input level to the demodulator at a constant level thereby obtaining optimum performance of the device.

The image tracking filter preferably comprises a broad bandwidth filter having a 150 MHz bandwidth at the lowest frequency channel.

The demodulator may comprise a phase-locked loop circuit having a phase detector, voltage controlled oscillator, loop amplifier and output buffer stage towards the compensation of differences between the voltage controlled oscillator frequency and the input to the demodulator means. The foregoing FM demodulator may of course be implemented with demodulators other than the phase-locked loop circuit disclosed herein.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a block diagram of the electrical components of the tuner-demodulator device;

Fig. 2 of the drawings is a schematic circuit diagram of the input section, V-H switch, first RF amplifier, image tracking filter and second RF amplifier portions of the tuner-demodulator device;

Fig. 3 of the drawings is a schematic circuit diagram of the mixer, the local oscillator, buffer and prescaler circuit portions of the tuner-demodulator device;

Fig. 4 of the drawings is a schematic circuit diagram showing the first intermediate frequency amplifier, filter, terrestrial interference filter and second intermediate frequency amplifier portions of the tuner-demodulator device;

Fig. 5 of the drawings is a schematic circuit diagram of the jumper portion of the circuitry; and

Fig 6 of the drawings is a schematic circuit diagram of the FM demodulator portion and automatic gain control portions of the tuner-demodulator device.

DETAILED DESCRIPTION OF THE DRAWINGS

While this invention is susceptible of embodiment in many different forms there is shown in the drawings and will herein be described in detail, one specific embodiment, with the understanding that the present disclosure is to be considered as an exemplification of the principles of the invention and is not intended to limit the invention to the embodiment illustrated.

Fig. 1 of the drawings is a block diagram of the electrical submodule portions of the tuner-demodulator device 10 forming the present invention. In its typically contemplated use, the present tuner-demodulator device is connected to and designed to accept a high frequency television signal input collected from a ground based satellite receiving antenna, such as a satellite dish and low noise block-down converter (LNB). The satellite dish accepts and receives a combined audio-video signal from an orbiting communication satellite and in turn conducts the received signal through the LNB to the tuner-demodulator towards the display of a television image upon a television monitor. The input portion of the device is formed by the connection of line 11 and line 12 to vertical-horizontal switch 13 (V/H switch) each of which conducts the LNB output signal from the satellite receiving dish and LNB to the tuner-demodulator device. Vertical/horizontal switch 13 serves to permit selection between the two inputs to the tuner-demodulator device towards accepting and/or compensating for systems which use either a vertically polarized or horizontally polarized signals,

as for example those systems using two inputs to permit selection between a 4 GHz signal in the C band or a 12 GHz signal in the KU band. V-H switch 13 is in turn shown connected to first radio frequency (RF) amplifier 15 which serves to amplify the high radio frequency-low power signal received by the satellite dish antenna and LNB.

First RF amplifier 15 is electronically connected to image tracking filter 16. Image tracking filter 16 is shown having a control input 17 designated "Vt". Vt control input 17 is adjustable and serves to designate the particular desired frequency and thus the particular channel of the television signal sought to be viewed. Vt control input 17 is further shown connected to voltage controlled oscillator 21 by connection 18. Image tracking filter 16 is thus shown connected to a second RF amplifier 19 which similarly amplifies the high frequency-low power signal which now corresponds almost solely to the television channel sought to be viewed.

The output of the second RF amplifier 19 is connected to mixer 20. Mixer 20 serves to combine the output of the second RF amplifier 19 with the output of a voltage controlled oscillator (VCO) 21. The Vt control input 17 is connected to voltage controlled oscillator 21 which is in turn controlled in part by the output of prescaler 22 which in conjunction with digital circuitry not shown serves to fine tune Vt control input 17. The output of mixer 20 is an intermediate frequency (IF) signal which is connected to bandpass filter 26 the output of which passes through terrestrial interference filter 27 or may bypass filter 27 by switches 29 and 30 which conduct the intermediate signal over bypass line 28. Thereafter the signal is conducted to second intermediate frequency amplifier 32 the output of which

is connected by input 33 to jumper 34. The output 35 of jumper 34 is thereafter conducted to demodulator 36 and detector 37 by way of line 42. Jumper 34 permits the present device to be expanded by allowing the signal to be connected to a separate filter system not a part of the present design. Demodulator 36 converts the intermediate frequency signal to a base band signal. With the external video demphasis/clamping and audio subcarrier demodulation circuits, the base band signal is capable of generating a video image and audio sound upon a television monitor.

Detector 37 has its output 39 connected to first intermediate frequency amplifier to provide for automatic gain control of the amplifier 25 by detecting the signal strength present in output 35 and comparing it to a preselected value and adjusting the gain of first intermediate frequency amplifier 25 accordingly. In the embodiment illustrated, the output 38 of demodulator 36 is connected to video amplifier 43 which provides an output 44 capable of connection to a television monitor through a de-emphasis and clamping circuit.

In the preferred embodiment of the invention, the tuner-demodulator device is fabricated upon a double-sided copper epoxy printer circuit board having an Er equal to 4.5 and a thickness of 1.6 mm. One side of the printed circuit board serves as a ground plane and both sides are interconnected at several places to improve the RF quality of the ground plane. Except for the required coils, all of the high frequency components, including transistors and varicaps, are preferably surface mounted devices which minimize parasitic effects and reduce the size of the device.

Fig. 2 of the drawings shows the schematic circuit diagram of V/H switch 13 (including inputs 11 and 12), first RF amplifier 15, image tracking filter 16 and second RF amplifier 19. V/H switch is shown being activatable by V/H input 14 which actuates a relay 50 to switch between inputs 11 and 12 respectively. The output of V/H switch 13 is connected to first RF amplifier 15 by line 51. First RF amplifier 15 is a broadband amplifier based upon a 2SC4093 transistor 52. The amplifier 15 utilizing the microstrip matching network builds a broadband amplifier covering the frequency range from 0.95 GHz to 1.75 GHz wherein a power gain of 6 dB may be obtained. Since emitter bonding wires may induce unwanted series feedback in the grounded emitter configuration, a dual emitter connection in the SOT-143 package is utilized. Moreover, a bias of 15 mA collector current in the transistor gives low intermodulation and optimum gain. The output of the first RF amplifier 15 is connected to the imaging tracking filter 16 by line 53. Unless otherwise specified on drawings, all capacitor values are in Farads, 50 volt rated, resistors are in Ohms, 1/10 W rated, inductors are in Henry, 1/10 W rated. MLIN, MLSC and MCLIN designations refer to microstrip line elements constructed directly in the printed circuit board.

Imaging tracking filter 16 is a bandpass filter. Although fixed filters are suitable for suppressing image and second IF breakthrough, they cannot suppress oscillator radiation to the antenna input connector due to the oscillator radiating at a frequency 480 MHz higher than the received channel which is in the incoming band when tuned to lower frequency satellite channels. Consequently, a tracked filter is required to isolate the local oscillator signal from the LNB input. To avoid oscillator tuning and tracking problems a broad

bandwidth filter, 150 MHz bandwidth at the lowest frequency channel, is chosen. The filter is tuned by two ISV186 varicap diodes which possess an extremely low capacitance, typically in the range of 0.66 to 0.82 pF. Preferably, the maximum/minimum capacitance ration is approximately 5.2 for a tuning voltage in the range of 2 to 20 volts.

The configuration is a conventional double tuned circuit. However for the high frequency application, the transformer is replaced by two coupled microstrip lines 54 and 55. Another two microstriplines 56 and 57 are used to match the double tuned filter to the transistors 52 and 59 of the first and second RF amplifiers. The insertion loss of image tracking filter 16 is approximately 3 dB.

The output of image tracking filter 16 is connected to second RF amplifier 19 by line 58 which is a broadband amplifier substantially identical to first RF amplifier 15 and likewise incorporates a 2SC4093 transistor 59. The output 60 of second RF amplifier 19 is connected to mixer 20 shown in Fig. 3.

Fig. 3 of the drawings is a schematic circuit diagram of voltage controlled oscillator 21 and mixer 22 portions of the tuner-demodulator device 10. Voltage controlled oscillator 21 incorporates a local oscillator and a buffer stage. For a single band tuner with a second IF of 479.5 MHz, the local oscillator frequency must be in the range of 1429.5 MHz to 2229.5 MHz. The local oscillator shown is a negative impedance oscillator incorporating a 2SC3583 transistor 61 having a collector-emitter voltage of 6 volts and a collector current of 8 mA. The local oscillator is tuned by two ISV186 varicap diodes 62 with resonant circuit inductance implemented by

copper strips 62a. The local oscillator is isolated from the mixer 20 by a 2SC3583 buffer stage 63 which prevents distortion and pulling of the oscillator by strong first IF signals applied at the mixer 20.

For compatibility with digital tuning systems, a prescaler is included in the tuner-demodulator device with input buffer 64. The prescaler divides the local oscillator frequency by 128 to lower the frequency to permit it to be read by an external microprocessor and external phase locked loop circuit thereby serving to control input Vt 17. Fine tuning of the selected channel is thereby possible.

Mixer 20 is based upon a NE41137 dual gate MESFET 66. Local oscillator isolation is inherent in the design as the output of local oscillator 21 fed to mixer 20 by line 65 and the first IF signal are injected to G2 and G1 respectively of MESFET 66. Filtering of the local oscillator and first IF signals is also done by the complex matching of gates. The NE41137 MESFET 66 in a common source configuration gives excellent intermodulating discrimination and a flat 4 dB conversion gain. The output of mixer 20 is connected to a bandpass filter to select a second IF signal of 479.5 MHz, and suppress the local oscillator and first IF signal. This second IF frequency reduces the number of first IF filters needed. Note also that all image frequencies are outside of the incoming down converted band. frequencies

Fig. 4 of the drawings shows the first intermediate frequency amplifier 25, filter 26, terrestrial filter 27 and second intermediate frequency amplifier 32. The output on line 67 of mixer 20 is connected to the first intermediate amplifier 25 which is a three stage amplifier incorporating transistors 68, 69

and 70 which are BF990 dual gate MOSFET, BFR92A and BFR92A types respectively. This amplifier possesses a gain of 44 dB. Gain control is implemented to achieve the required -5dB signal level at the input of the phase-locked loop (PLL) demodulator 36 while providing a low intermodulation in the second IF stages. A gain control range of 40 dB is achieved which is sufficient to handle a variety of specific receiving conditions, such as different antenna diameters, divergent satellite power levels and cable losses. Currents in the different stages have been chosen to give both low power consumption and minimum intermodulation.

To suppress adjacent channel interference, a ceramic printed filter 71 with a center frequency of 479.5 MHz and a 27 MHz passband is utilized.

In addition, a switchable terrestrial interference filter 27 having a 13 MHz passband is provided to suppress terrestrial interference and noise created by local television stations present in some geographic regions. Inductors 72 and 73 create the required notch filter.

The output on line 74 of terrestrial filter 27 is connected to the second intermediate amplifier 32 which is a two stage amplifier incorporating transistors 75 and 76 which are both BFR92A type. Transistors 70 and 75 are additionally 50 ohm matched transistors for proper driving of the filters therebetween.

The output 33 of second intermediate frequency amplifier 32 is connected to jumper 34, Fig. 5, the output 35 of which is connected to demodulator 36 and by line 42 is connected to detector 37 for automatic gain control of first IF amplifier 25. Jumper 34 is provided

to permit the connection of an external filter for future use. Absent use of an optional external filter, the output of second intermediate frequency amplifier 32 is connected to demodulator 36 and detector 37 as above described.

Fig. 6 of the drawings shows the schematic circuit diagrams for demodulator 36, detector 37 and video amplifier 43. Output 35 from jumper 34 is connected to demodulator 36 and to detector 37 by line 42. FM demodulator 36 converts the incoming frequency modulated signal to a baseband signal. While frequency demodulation can be accomplished using a number of methods, the present tuner-demodulator device utilizes a phase-locked loop method though such other methods are contemplated and deemed within the scope of the invention. The phase-locked loop method has the advantage of being able to flexibly handle a variety of television formats presently available, as well as new formats such as HDTV (high definition television) or MAC TV transmissions. Phase-locked loop also allows for extension of the carrier to noise (C/N) ratio threshold which prevents annoying deterioration in picture quality at low C/N ratios. Other qualities of the present design are high signal output and ease of adjustment.

The phase-locked loop FM demodulator 36 consists of a phase detector, voltage controlled oscillator, loop amplifier and output buffer stage. When the phase-locked loop is locked, the instantaneous voltage controlled oscillator frequency will always try to follow the IF input frequency, and the phase detector outputs an error voltage if the two frequencies are different. This error voltage is integrated by a lag/lead type loop filter and corrects the voltage controlled oscillator frequency through a DC amplifier.

The value of the loop filter components depend on both the incoming satellite signal modulation and the type of television signal to be processed. The components are readily common and chosen to give optimum threshold extension. The demodulated signal is buffered by three transistors 77, 78 and 79 to that the output loading and the demodulator are fully isolated.

Detector 37 serves to detect any difference between the IF signal strength and a preset value by means of comparitors 80 and 81 both of which are LM358N type and diode 82 a ISS106 type. Detector 37 functions as an automatic gain control by adjusting the gain of first intermediate frequency amplifier 25 based upon the outcome of the comparison made by detector 37. The foregoing serves to keep a constant input signal level at the demodulator to thereby maintaining optimum performance.

Output 83 thus comprises a baseband raw video signal suitable for use by accompanying system circuitry.

The foregoing description and drawings merely explain and illustrate the invention and the invention in not limited thereto, except insofar as the amended claims are so limited as those skilled in the art who have the disclosure before them will be able to make modifications and variations therein without departing from the scope of the invention.

CLAIMS

-1-

A self contained tuner-demodulator device for use with a ground based satellite signal reception antenna and low noise block down converter (LNB) capable of capturing satellite signals and of providing a LNB output signal to a satellite receiver unit toward the viewing of a television display monitor, said tuner-demodulator device comprising:

- input means for operably and electrically connecting said tuner-demodulator device to said satellite signal reception antenna and said low noise block down converter;

- first radio frequency amplifier means operably and electrically connected to said input means for amplifying said received LNB output signal;

- local oscillator means for use in converting the high frequency LNB output signal to an intermediate frequency signal;

- buffer means operably and electrically associated with said local oscillator means for isolating said local oscillator means to prevent unwanted distortion of said LNB output signal;

- image tracking filter means operably and electrically connected to said first radio frequency amplifier means, said image tracking filter means serving to select a desired channel;

- second radio frequency amplifier means operably and electrically connected to said image tracking filter means for amplifying said LNB output signal corresponding to the selected channel;

- mixer means operably and electrically connected to said local oscillator means, said buffer means and said second radio frequency amplifier means for combining said LNB output signal and the output of said oscillator means towards generating a reduced frequency signal corresponding to the selected channel in the intermediate frequency band;

- first intermediate frequency amplifier operably and electrically coupled to said mixer means, said first intermediate frequency amplifier means serving to amplify said intermediate frequency signal corresponding to the selected channel;

- first filter means operably and electrically connected to said first intermediate frequency amplifier means;

- second intermediate frequency amplifier means operably and electrically coupled to said first intermediate frequency amplifier means, said second intermediate frequency amplifier means serving to further amplify said intermediate frequency signal corresponding to the selected channel;

- demodulator means operably and electrically connected to said second intermediate frequency amplifier means for converting said intermediate frequency signal corresponding to the selected channel to a baseband signal;

whereby a signal suitable for use with a satellite receiver unit and television display monitor is generated.

-2-

The invention according to Claim 1 in which said tuner-demodulator device further includes an input means having a vertical/horizontal switch operably associated with said input means to switch between horizontally polarized and vertically polarized input signals as desired.

-3-

The invention according to Claim 1 in which said tuner-demodulator device further includes a prescaler means for providing compatibility with digital tuning systems having a computer interface for digital tuning and control tuning systems.

-4-

The invention according to Claim 1 in which said tuner-demodulator device further includes a second filter means operably and electrically associated with said mixer means towards suppressing said local oscillator means and first intermediate signals, said second filter means comprising a bandpass filter configured to select a second intermediate signal of 479.5 MHz.

-5-

The invention according to Claim 1 in which said tuner-demodulator device further includes a

terrestrial interference filter having a 13 MHz passband for terrestrial noise and interference suppression.

-6-

The invention according to Claim 1 in which said tuner-demodulator device further includes jumper means operably and electrically connected between said second intermediate frequency amplifier means and said demodulator means, said jumper means serving to permit the interconnection of external circuitry components into said tuner-demodulator device.

-7-

The invention according to Claim 1 in which said tuner-demodulator device further includes detector means operably and electrically connected to said second intermediate frequency amplifier means and said first intermediate frequency amplifier means for providing automatic gain control of said first intermediate frequency amplifier means towards maintaining the input level to said demodulator means at a constant level to obtain optimum performance.

-8-

The invention according to Claim 1 in which said image tracking filter means comprises a broad bandwidth filter having a 150MHz bandwidth at the lowest frequency channel.

-9-

The invention according to claim 1 in which said first intermediate frequency amplifier means includes dual emitter connected, SOT-143 packaged

transistors to minimize unwanted series feedback.

-10-

The invention according to Claim 1 in which said first filter means comprises a ceramic printed filter having a center frequency of 479.5 MHz and a 27 Mhz passband.

-11-

The invention according to Claim 1 wherein said local oscillator means comprises a voltage controlled oscillator.

-12-

The invention according to Claim 5 wherein said terrestrial interference filter may be selectively switched to cause said LNB output signal to pass through said terrestrial interference filter or alternatively bypass said terrestrial interference filter.

-13-

The invention according to Claim 1 in which said demodulator means comprises a phase-locked loop circuit having a phase detector, voltage controlled oscillator, loop amplifier and output buffer stage to thereby compensate for any differences between the voltage controlled oscillator frequency and the input to the demodulator means.

-14-

A Tuner-demodulator device as claimed in Claim 1 substantially as described herein with reference to Fig. 1 of the accompanying drawings.

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